

## Flow Visualization 4151-003: Team Third

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The third team project was completed with the help of Tara Fisch (she helped with lighting briefly). The intent of the image was originally to capture a helical flow we noticed coming out of the cocktail shaker during the first team assignment. We were unable to capture this phenomenon, so I instead took photos of the gravity flow and the patterns formed on the table the smoke was poured onto.

As seen in the above picture, CO<sub>2</sub> gas was poured from a cocktail shaker onto a black tabletop to add contrast to the flow. What's being seen is a gravity flow. This flow occurs when a gas with a slightly lower density than the surrounding fluid (in this case, the air) flows outward along a surface creating a wave-like pattern with varying wave thickness (not density) [1]. The width of the thickest ring shown is about 5 inches. From this image alone, it would be impossible to quantify any useful values. However, if the experiment were to be repeated with measurements taken for the flow, a Froude number could be calculated to determine the behavior of the moving front. This equation is given by

$$Fr = \frac{u_f}{\sqrt{g'h}}$$

Where  $Fr$  is the Froude number,  $u_f$  is the flow speed,  $g'$  is the reduced gravity, and  $h$  is the height of the box encapsulating the section of flow being observed.

The visualization technique used is CO<sub>2</sub> gas poured from a cocktail shaker onto a black table for contrast. The room was lit with overhead lights, but this was still not enough so an LED flashlight was held about a foot away from the smoke at the top right of the picture to help illuminate the details in the smoke a bit more. The smoke was created by adding dry ice to boiling water and waiting for the intense off-gassing to subside for about 30 seconds before pouring.

The FOV size is only about 6 inches from left to right of the picture with the subject being about 6 inches from the front of the camera. A Canon T6i was used with f/4.5, 1/400 second exposure, ISO-6400, and 34mm focal length. Both the original and edited photos came to be 6000x4000 pixels. Below is the original unedited picture.



In essence, this image reveals a fascinating gravity flow along the top of the table. I really like how the edited piece turned out, but I do wish the framing was a bit different. It was extremely difficult to adjust the camera, take the picture, pour the smoke, and control the lighting simultaneously while ensuring that the dry ice in the cocktail mixer doesn't completely vaporize. Otherwise, the original intent of capturing the helical flow was not fulfilled. This is fine, as it revealed a different, still interesting flow. Next time, I would like to use a macro lens to capture the smaller details in the shot.

## *References*

[1] [https://en.wikipedia.org/wiki/Gravity\\_current](https://en.wikipedia.org/wiki/Gravity_current)